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THE EFFECT OF EMPHASIZING PRODUCTION TYPEWRITING, CONTRASTED WITH SPEED TYPEWRITING IN DEVELOPING PRODUCTION TYPEWRITING ABILITY. SOUTH-WESTERN MONOGRAPHS IN BUSINESS AND ECONOMIC EDUCATION, NUMBER 97.

BY- CRAWFORD, THOMAS JAMES

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THE PURPOSE OF THIS STUDY WAS TO COMPARE TWO TEACHING METHODS FOR DEVELOPING PRODUCTION TYPEWRITING ABILITY. THE TRADITIONAL, SPEED-EMPHASIS METHOD AND THE EXPERIMENTAL, PRODUCTION-EMPHASIS METHOD, WERE USED DURING 50-MINUTE PERIODS FOR 61 SESSIONS EACH SEMESTER WITH STUDENTS ENROLLED IN INTERMEDIATE TYPEWRITING AT INDIANA UNIVERSITY DURING 1954-55. DURING THE FIRST SEMESTER, THERE WERE 37 STUDENTS IN THE CONTROL GROUP AND 85 STUDENTS IN THREE EXPERIMENTAL-GROUP CLASSES. IN THE SECOND SEMESTER, THERE WERE 22 STUDENTS IN THE CONTROL GROUP AND 82 STUDENTS IN THE THREE EXPERIMENTAL CLASSES. THE TWO GROUPS WERE EQUATED IN TERMS OF INITIAL PRODUCTION, NET STROKING, NET PERFORMANCE, RELATED INFORMATION, PSYCHOLOGICAL SCORE, AND READING COMPREHENSION. AT THE BEGINNING AND END OF EACH SEMESTER, TESTS OF PRODUCTION ABILITY, NET STROKING SPEED, NET PERFORMANCE, AND RELATED INFORMATION WERE ADMINISTERED. AT THE BEGINNING OF THE EXPERIMENT IN BOTH SEMESTERS, THE CONTROL GROUP SHOWED HIGHER PRODUCTION ABILITY THAN THE EXPERIMENTAL GROUP. AT THE END OF THE FIRST SEMESTER, THE EXPERIMENTAL GROUP HAD A FINAL PRODUCTION-RATE MEAN OF 13.15 WORDS PER MINUTE (WPM) AND THE CONTROL GROUP A MEAN OF ONLY 7.70 WPM. AT THE END OF THE SECOND SEMESTER, THE EXPERIMENTAL-GROUP MEAN WAS 13.17 WPM AND THE CONTROL GROUP 8.23 WPM. IT WAS RECOMMENDED THAT TYPEWRITING COURSES BE ORGANIZED TO INCLUDE INTENSIVE INSTRUCTION IN PRODUCTION TECHNIQUES AND PROCEDURES. ADDITIONAL FINDINGS AND IMPLICATIONS ARE GIVEN. THIS IS AN ABSTRACT OF A PH.D. DISSERTATION COMPLETED AT THE UNIVERSITY OF PITTSBURGH IN 1956. (PS)

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PRODUCTION TYPEWRITING

T. JAMES CRAWFORD

SOUTH-WESTERN MONOGRAPHS
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THE EFFECT OF EMPHASIZING

PRODUCTION TYPEWRITING

CONTRASTED WITH SPEED TYPEWRITING IN DEVELOPING PRODUCTION TYPEWRITING ABILITY

An Abstract

by

THOMAS JAMES CRAWFORD
School of Business
Indiana University
Bloomington, Indiana

This monograph contains an abstract of a study completed at the University of Pittsburgh in partial fulfillment of the requirements for a Ph.D. degree in 1956. This study was selected as the winning Delta Pi Epsilon Research Award Study for 1956.

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PREFACE

Delta Pi Epsilon, a graduate honorary fraternity in business education, selects each year a study that the Research Award Project Committee feels is a significant research contribution to the professional field of business education. The 1957 Research Award was presented to Dr. T. James Crawford, Associate Professor of Business Education at Indiana University, Bloomington, Indiana. Professor Crawford's Ph.D. doctoral study was completed at the University of Pittsburgh.

The Research Award Project Committee was composed of:

Dr. John L. Rowe (chairman), University of North Dakota

Dr. Harry Huffman, Virginia Polytechnic Institute

Dr. F. Wayne House, University of Nebraska

Dr. Russell Sickelbower, San Francisco State College

The Fraternity is deeply grateful to the South-Western Publishing Company for publishing this abstract of the award-winning study and thereby making it readily available to people in the field of business education.

DR. DOROTHY H. VEON
Pennsylvania State University
National President, 1958 and 1959
Delta Pi Epsilon

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I. INTRODUCTION

A. General

Through the years, skill in typewriting has been appraised, generally, in terms of the ability of the typist to compile quantities of key strokes within specified time limits. Results of tests administered to measure that skill have been reported as rates-per-minute, reflecting both quantity (speed), and quality (accuracy) of performance. Degrees of competence have been determined, largely, by the magnitude of the key stroke-producing rates; and common practice has been to identify typists with the highest stroking rates as those most capable. Yet, other experiences in the classroom and in the business office have caused questions to be raised concerning the advisability of using a measure of stroke-accumulating skill as a reliable index of the true stature of a typist.

Teachers and businessmen alike have long been aware of the performance gaps existing between the ability of a typist to produce key strokes and his ability to apply that stroke-producing skill to problem-solving experiences. They have found, too, that in many instances the typist possessing the highest key-stroking rate is not always the most competent in typing problems or jobs requiring the application of that skill. Consequently, in recent years measurement in typewriting has shifted from a narrowly restrictive emphasis on stroking speed alone to a more comprehensive one, including, in addition to stroking skill, measures designating the ability of the typist to produce quantities of problems or typical business jobs in given periods of time. The term "production typewriting" has been assigned to this newer, more all-inclusive objective.

Production typewriting has had various interpretations by teachers interested in having their typists develop that power. Some have considered it to mean repetitive copying of selected jobs, excluding such related activities as making machine adjustments and correcting errors, to determine the ability of a typist to produce volumes of work on limited, specialized problems. Others have viewed the scope of production more broadly and have administered tests under the same general conditions, but have required performance on several different jobs rather than on just one. Practically all tests, however, have been of short duration and have excluded many of the related factors which have a direct bearing on production performance results. Considerable confusion in production typewriting has existed, therefore, because of controversies centering around production-measurement issues such as (a) restricted versus varied subject matter, (b) short versus long testing time-intervals, and (c) the inclusion or exclusion of related nontyping activities; and there has emerged an urgent need for scientific evidence to help resolve some of the doubts, questions, and conflicting points of view held by educators interested in improving production typewriting instruction.

In this study, production typewriting has been defined most comprehensively to include all activities involved in the process of completing jobs from the time they are received until the time they are finished. Production typewriting includes in the performance time such important related requirements as following variously specified directions, computing the spacing needed for copy arrangement, making necessary machine adjustments, handling materials, preparing carbon copies, proofreading, correcting occurrent errors, and appropriately disposing of the finished products. Instead of covering relatively short time intervals of fifteen or twenty minutes' duration, the production test used in this investigation is designed for a prolonged period of time covering two hours, or 120 test-minutes. Production rates computed and reported in this study, then, reflect total problem-solving performance rather than piecemeal behavior.

Performance results on production tests have been reported in various ways. One common procedure has been to measure, on tests consisting of only one particular job, the total number of completed copies typed in a specified time, and the results have been reported in terms of completed units or portions thereof produced in the time allowed. Another approach has been to measure, in the same way, performance from a variety of selected problems rather than from just one job. A very popular procedure has been to express, for tests consisting of a variety of different jobs, production-performance ability as a percentage figure representing a ratio of production skill to key-stroking skill. All of the procedures mentioned, however, have been subject to critical analysis because of questions concerning the meaningfulness of the vehicles of expression used to report test results. General consensus has suggested that appraisal of production performance has been somewhat obscure because of lack of uniformity in measurement practice and because, further, the terms used to describe the extent of test accomplishment have not been especially meaningful to those not acquainted with the specific ingredients of the tests used. Since it has been customary to think of typewriting ability in terms of stroking skill and since it is common practice to compare performance on production tests with that on straight-copy writings, production-test results computed for this study have been reported as rate-per-minute figures with the required activities previously enumerated reflected in those scores.

Though production typewriting has come to occupy an increasingly prominent place in typewriting instruction, little has been done scientifically to develop effective teaching methods for developing production ability. Three different current methods tend to represent most common practice. The first of the three places maximum teaching emphasis upon the building of key-stroking skill and minimum stress upon building skill in problem typing. The second uses a piecemeal approach by emphasizing intensive drill on the component parts of typical business problems, and the third method stresses short-interval tests covering varied business jobs requiring the completion of nontyping as well as regular typewriting activities. None of the methods cited, however, has attempted to develop production ability for sustained periods of time nor have they required the inclusion of total-performance requirements. Moreover, even though several different teaching methods for developing production power have evolved, no attempt, heretofore, has been made to determine the relative merits of those in use. The intent of this particular investigation, then, was to compare the effectiveness of contrasted teaching methods used in building production power.

B. Purpose

Specifically, the purpose of this study was to determine the effect of emphasizing production typewriting contrasted with speed typewriting in developing production typewriting ability. Answers to questions involving the following six related areas were sought: (1) comparisons of group performance for classes taught by contrasted methods, (2) comparisons of performance for individuals matched on selected factors and taught by contrasted methods, (3) comparisons of production-performance rates with net stroking and net performance rates, (4) comparisons in production performance of testees in the upper and lower distribution limits, (5) comparisons of gains in selected related areas for classes taught by contrasted methods, and (6) relationships between production-rate gains and selected related factors. To find answers to the questions propounded, two contrasted teaching methods — identified as (a) the traditional, speed-emphasis method; and (b) the experimental, production-emphasis method — were delineated and a formal research covering one academic year was conducted.

II. PROCEDURE

Students enrolled in Intermediate Typewriting at Indiana University during the academic year, 1954–55, comprised the groups used in this experiment. In each of the two semesters covered by this study, testees were divided into one control-group class and three experimental-group classes. During the first semester, there were thirty-seven students in the control group and a total of eighty-five students in the experimental group; in the second semester, there were twenty-two students in the control group and a total of eighty-two students in the experimental group. Four different teachers ranging in experience from no prior teaching experience to a total of fifteen years' experience provided the instruction. The control-group teacher had seven years' experience; and the three teachers handling the experimental classes had an average of seven years' experience, with one having fifteen years', another six years', and the third no previous experience.

At the beginning of each semester, four tests were administered to all testees to determine their initial status in production ability, net stroking speed, net performance speed, and related information. At the end of each semester, the same tests were readministered to ascertain terminal status in the same four areas. Comparisons between the two sets of scores were drawn to learn the extent of gain achieved on each test throughout the semester. Once during each semester, an arithmetic test consisting of forty-eight questions covering the fundamental processes was given to find the general arithmetic ability of the students.

In addition to the performance-test data assembled for each testee, scores indicating their levels of general intelligence and their levels of reading comprehension were compiled from records made available through the Indiana University Bureau of Measurement.

The control and experimental groups were equated in terms of six different factors. On all but the production test of the first semester, there were no statistically significant differences between the control and experimental groups on any of the factors measured. (See Table I.)

TABLE I

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON INITIAL PRODUCTION TEST

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	4.00	1.14	5.25*
	Exper.	85	2.62	1.39	
2nd.	Control	22	4.68	1.66	0.27
	Exper.	82	4.57	1.68	

*Significant at the .01 level of confidence

In the first semester, the control group, with an initial production-rate mean of 4.00 w.p.m. (words a minute), demonstrated greater ability in production typewriting than the experimental group which had an initial production-rate mean of 2.62 w.p.m. The difference between the means favoring control-group testees was significant at the .01 level of confidence. In the second semester, too, the control group (4.68 w.p.m.) demonstrated greater production typewriting ability than the experimental group (4.57 w.p.m.); however, that difference was not statis-

tically significant. Even though, in the first semester, the control group had a decided advantage over the experimental group on initial production performance, no adjustments in the groups were made since the advantage favored the group not emphasizing the experimental factor.

Even though the classes of both semesters represented an organization resulting from normal enrollment procedures, there were no significant differences favoring the experimental over the control group in any one of six factors used for equating the groups. The following tables, II through VI, show the results of the tests administered for equating purposes:

TABLE II

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON INITIAL NET STROKING TEST

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	42.68	11.39	0.56
	Exper.	85	41.13	14.93	
2nd.	Control	22	41.82	10.19	0.66
	Exper.	82	39.73	13.62	

TABLE III

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON INITIAL NET PERFORMANCE TEST

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	38.19	9.56	0.85
	Exper.	85	36.19	12.64	
2nd.	Control	22	36.96	9.42	0.79
	Exper.	82	39.17	12.04	

TABLE IV

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON INITIAL RELATED INFORMATION TEST

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	65.54	21.87	1.14
	Exper.	85	60.76	20.77	
2nd.	Control	22	70.27	17.19	0.95
	Exper.	82	66.14	18.19	

TABLE V

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON ACE PSYCHOLOGICAL EXAMINATION

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	44.08	26.57	1.13
	Exper.	85	50.02	26.38	
2nd.	Control	22	42.77	21.53	0.66
	Exper.	82	46.91	26.15	

TABLE VI

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON COOPERATIVE ENGLISH TEST, TEST C_2

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	36.89	22.47	0.82
	Exper.	85	40.93	25.77	
2nd.	Control	22	31.86	17.15	1.40
	Exper.	82	39.48	23.64	

To provide additional comparisons of production performance by students in the contrasted groups, individuals were matched in terms of four different criteria: initial production ability, initial net stroking rates, age, and sex classification. To be considered in the matching of individuals, testees had to be matched on all four of the criteria enumerated. In the first semester, twenty-four control-group subjects (or 64.86 per cent of the total) were matched with testees from the experimental group; and in the second semester, thirteen control-group testees (or 59.09 per cent of the total) were matched with experimental-group testees.

In each of the two semesters covered by this investigation, there were a total of sixty-one class periods for both the control and experimental groups. All classes met four days a week—Monday, Tuesday, Thursday, and Friday, with class periods extending for a total of fifty minutes. No outside instruction, no additional practice or review time other than that provided in the regular class sessions were permitted; and all activities performed during the investigation were completed during the fifty-minute class periods. The results of this study, therefore, reflect only those activities actually performed by students in the classroom during fifty-minute periods covering a total of sixty-one sessions. A comparative breakdown of the distribution of semester time for both the control and experimental groups follows:

Activity	Control Group in Class Periods	Experimental Group in Class Periods
Organization and Pre-Instruction Orientation	3	3
Speed Building	30	0
Production Typewriting	15	45
Administration of Tests	13	13
Total Periods in Semester	61	61

Both the control group and the experimental group were required to cover the same problem areas in preparation for the production tests administered. Though the same subject matter was covered, the control group spent only one third of the time used by the experimental group in covering the various problem areas. Compared to the forty-five class periods used by the experimental group, the control group had only fifteen class periods to cover the same amount of subject matter. A breakdown of the distribution of instruction time for the various problem areas follows:

Basic Problem Area	Class Periods for Control Group	Class Periods for Experimental Group
Preparation of Communications	5	15
Copy Arrangement	4	12
Alignment of Copy	2	6
Sustained Production Tests	4	12
Total	15	45

For each of the problem areas covered, therefore, the control group devoted only one third of the time used by the experimental group. While the experimental group devoted all instruction time to production typewriting, the control group spent two thirds of the instruction time on speed building and only one third of the time on production typewriting. Students in the experimental group covered the various problem areas according to the three-phase cycle consisting of: (1) learning, (2) skill building, and (3) measurement; control-group students did not follow the cycle. The results of the study, therefore, reflect not only the presence or absence of speed building and a difference in instruction emphasis, but also the effect of applying a new organization and plan for teaching problem and production typewriting.

The statistical treatment of scores was handled in several different ways. To measure the significance of difference between mean performance, Student's t-test was employed; and the F-test, or variance ratio, was used to measure the significance of difference when initial variations were adjusted. To determine the extent of relationship between production gains and selected related factors, Pearson's product-moment coefficient of correlation was computed. Tables were constructed to present statistical evidence of group performance, and figures were prepared to portray the performance of individuals.

III. FINDINGS

A. Production-Test Performance for Contrasted Groups

TABLE VII

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON INITIAL AND FINAL PRODUCTION TESTS

			Initial Prod. Test			Final Prod. Test		
Sem.	Group	N	Mean wpm	S.D.	t Test	Mean wpm	S.D.	t Test
1st.	Control	37	4.00	1.14	5.25*	7.70	2.75	6.36*
	Exper.	85	2.62	1.39		13.15	4.35	
2nd.	Control	22	4.68	1.66	0.27	8.23	2.66	5.15*
	Exper.	82	4.57	1.68		13.17	4.23	

*Significant at the .01 level of confidence

On initial production tests, the control groups had higher production-rate means than the experimental groups. In the first semester, the difference between the means was pronounced, having a t-test value significant at the .01 level of confidence; in the second semester, however, the difference favoring the control group was only a slight one, having no statistical significance. Thus, at the beginning of the experiment in both semesters, control-group testees showed higher production ability than experimental-group ones. On final test performance, however, the opposite condition existed.

Contrary to initial status, experimental-group testees demonstrated greater terminal production performance ability than control-group testees. In the first semester, the experimental group had a final production-rate mean of 13.15 w.p.m. and the control group, a mean of only 7.70 w.p.m.; in the second semester, the experimental-group mean was 13.17 w.p.m. and the mean for the control group, 8.23 w.p.m. Both in the first and second semesters, the differences between the means favoring the experimental groups were significant at the .01 level of confidence. Worthy of note is the fact that, in the first semester, the experimental group having decidedly less ability in production performance than the control group at the beginning of the study, demonstrated impressively greater performance at the end of the investigation. The original superiority of the control group was not retained; instead, the experimental group compensated for its original deficit and surpassed by a decisive margin the performance of the control group. In the second semester, too, the experimental-group performance greatly exceeded that of the control group in spite of the fact that, on initial ability, the control group held a slight advantage. In terms of terminal performance, then, the production-performance ability was significantly higher for the production-emphasis groups than for the speed-emphasis groups; all evidence compiled for the contrasted groups, therefore, pointed to the superiority of the experimental method over the traditional method.

Taking cognizance of the fact that terminal scores might be influenced by differences existing at the outset of the study, performance means were adjusted statistically to account for possible initial differences. A study of the adjusted means also indicated that the experimental group greatly surpassed the control

group in final production performance. In the first semester, the adjusted mean for the control group was 7.31 w.p.m. and for the experimental group, 13.32 w.p.m.; in the second semester, the control-group adjusted mean was 8.09 w.p.m., and the experimental-group adjusted mean, 13.22 w.p.m. Thus, both adjusted means favored decisively the experimental groups.

Still another test for significance of difference in mean performance was applied. The covariance analysis or F-test was used in both semesters to find the variance ratio between groups. In both instances, the experimental groups far exceeded the control groups in production ability. The F values computed for the two semesters (84.95 in the first, and 63.01 in the second) were significant beyond the .01 level of confidence. Accounting for initial performance differences, then, two different statistical measures showed that the experimental-method students were decidedly better in terminal ability than the control-method students.

Group performance was also appraised in terms of the amount of gain achieved between initial and final tests. Production-gain means were compared and the t-test for significance of difference between the means was applied.

TABLE VIII

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON PRODUCTION-RATE GAIN

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	3.72	2.46	10.16*
	Exper.	85	10.53	4.11	
2nd.	Control	22	3.36	1.77	7.57*
	Exper.	82	8.58	3.14	

*Significant at the .01 level of confidence

In both semesters, the experimental groups produced substantially greater gains than the control groups, with their t-test values indicating significance at the .01 level of confidence.

An inspection of the comparative performance of individual testees having similar initial production scores in the contrasted groups disclosed a general trend showing the experimental-group typists excelling the control-group ones in production growth.

From all of the evidence available, therefore, it may be asserted that typists trained by the production-emphasis method develop significantly greater production ability than typists trained by the speed-emphasis method.

B. Production-Test Performance for Matched Individuals

The production-test results for individual testees matched on four criteria were studied to discover the effect of contrasted teaching methods on production typewriting ability. Initial and terminal performance were compared and the extent of gains computed.

TABLE IX

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF MATCHED INDIVIDUALS ON PRODUCTION RATE GAIN

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	24	3.88	2.3	7.00*
	Exper.	24	9.25	2.8	
2nd.	Control	13	3.54	2.1	5.90*
	Exper.	13	8.46	2.0	

*Significant at the .01 level of confidence

Results for both semesters favored testees in the experimental group. In both semesters, the experimental-group testees achieved statistically greater gains in production performance than the control-group testees. Evidence compiled for the performance of matched individuals, then, supported the findings available for group accomplishment; in both cases, the experimental-method students showed a decided superiority over the control-method students in production performance.

C. Comparisons Between Production, Net Stroking, and Net Performance Rates

To learn the effect of problem-solving requirements on production rates and to compare production performance with straight-copy skill, achievements on net stroking, net performance, and production tests were analyzed. (See Figures 3 through 6 on following pages.)

From the evidence available, several pertinent observations may be deduced: (1) that the levels of performance in production typewriting were consistently and appreciably lower than the levels of net stroking skill; for typists in the middle and upper net stroking brackets, the differences between key-stroking and production were extreme, while those in the lower division were more moderate; (2) that the level of skill in net stroking was not necessarily indicative of the level of achievement in production typewriting; often typists with lower net stroking rates performed better on production tests than typists with comparatively higher stroking rates; (3) apart from specific training for that purpose, net stroking skill did not transfer automatically to production typewriting; specific instruction in production procedures had to be provided in order to realize increases in production performance rates; (4) on all levels, there were extreme differences between stroking speed and production performance; both in the upper and lower ends of the distribution, there were pronounced gaps between net stroking and production; and (5) after specific instruction especially emphasizing production typewriting, production performance showed appreciable improvement; testees taught by the production-emphasis method showed impressively greater gains in production ability than those taught by the speed-emphasis method. All evidence pointed to the superiority of the experimental over the control method.

Comparisons between the net stroking and net performance rates showed that key-stroking skill is materially influenced when additional requirements are demanded during the period of timing. On tests requiring the preparation of a carbon copy and the correction of all occurrent errors, performance rates varied considerably. As a general trend, scores on net performance were lower than those on net stroking; however, there were numerous exceptions to the over-all pattern. In the first semester, for example, on initial tests twenty-eight testees, or 22.95 per cent of the total, had higher net performance rates than net stroking rates;

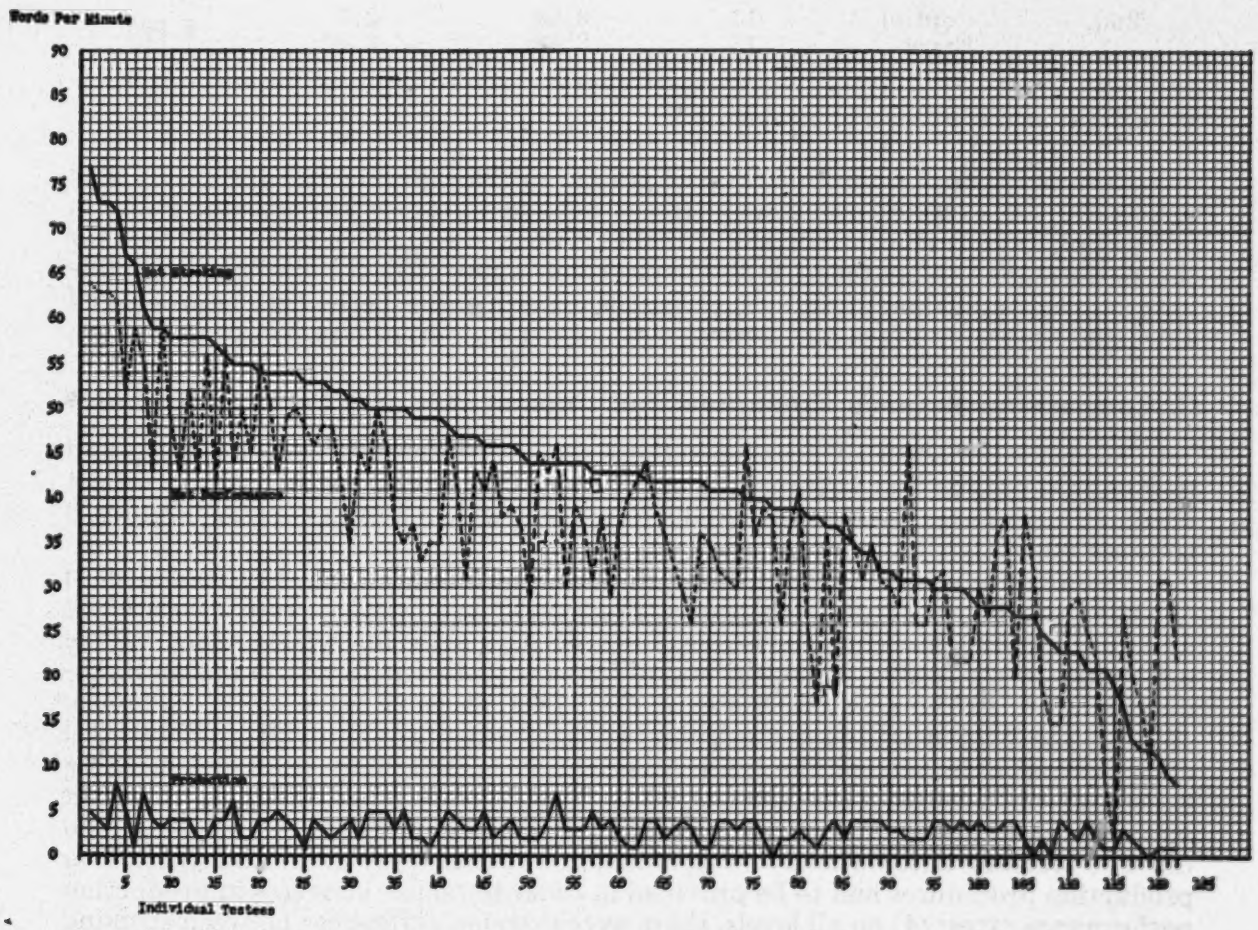

Figure 1. Initial Net Stroking, Net Performance, and Production Rates for First-Semester Testees

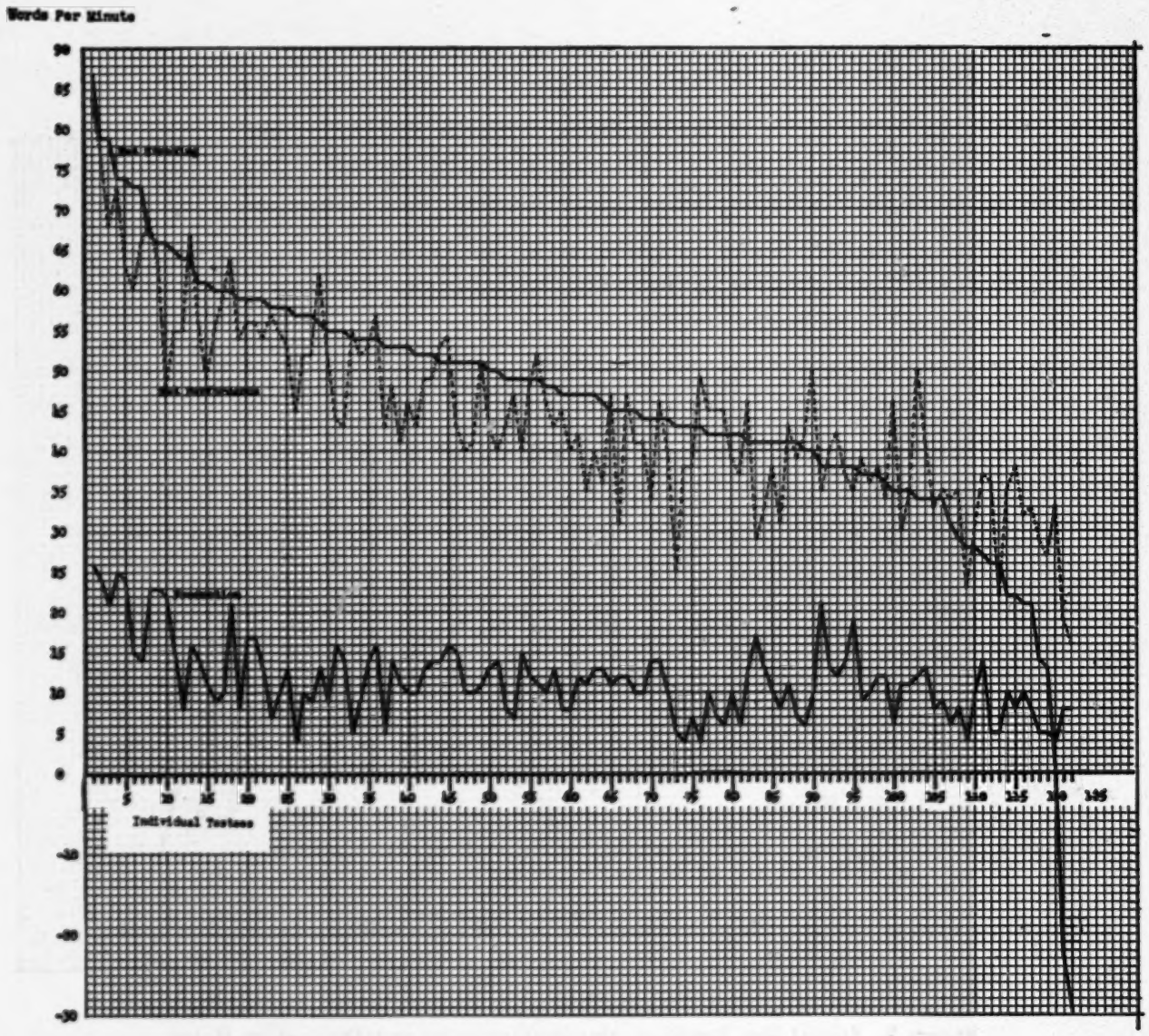

Figure 2. Final Net Stroking, Net Performance, and Production Rates for First-Semester Testees

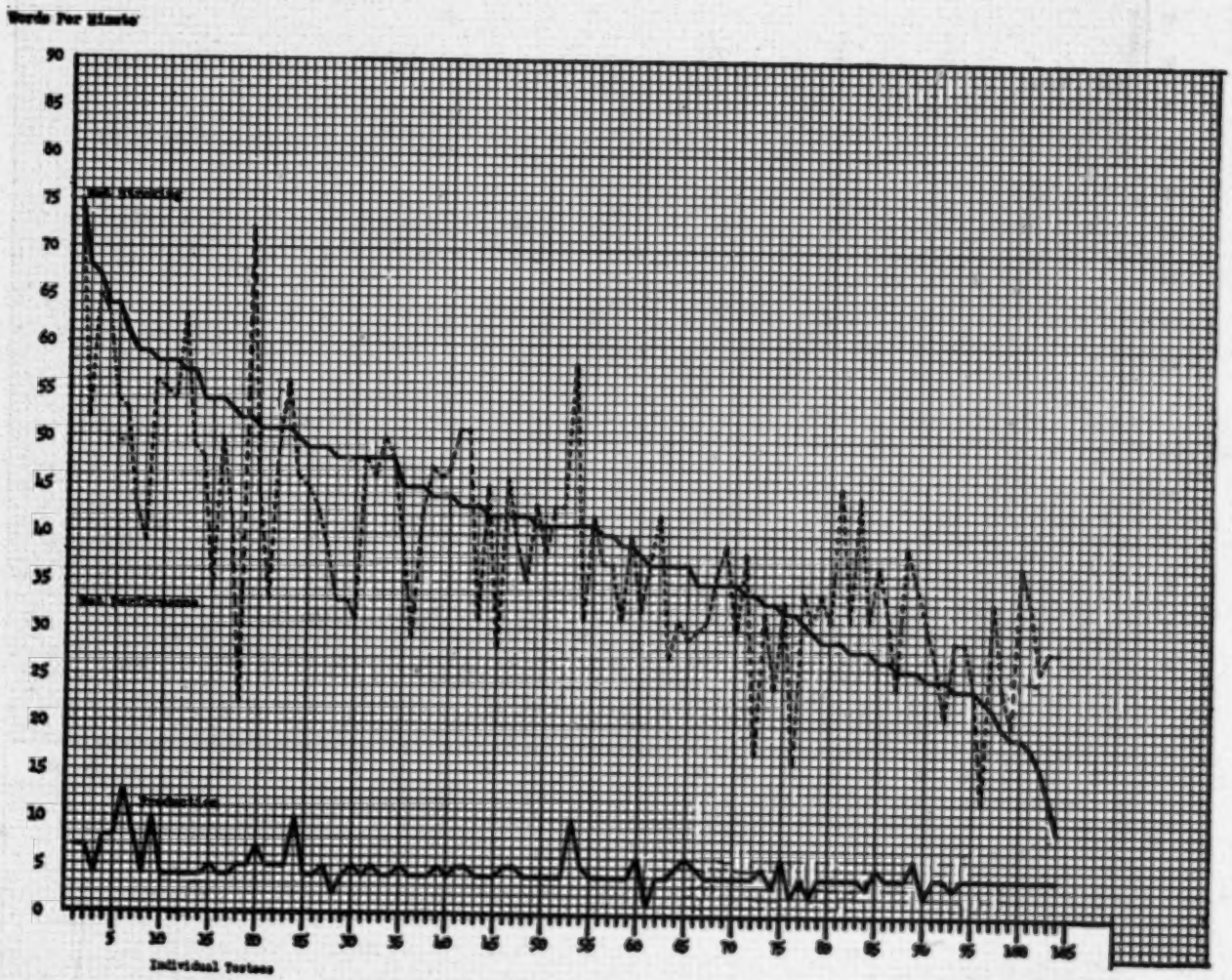

Figure 8. Initial Net Stroking, Net Performance, and Production Rates for Second-Semester Testees

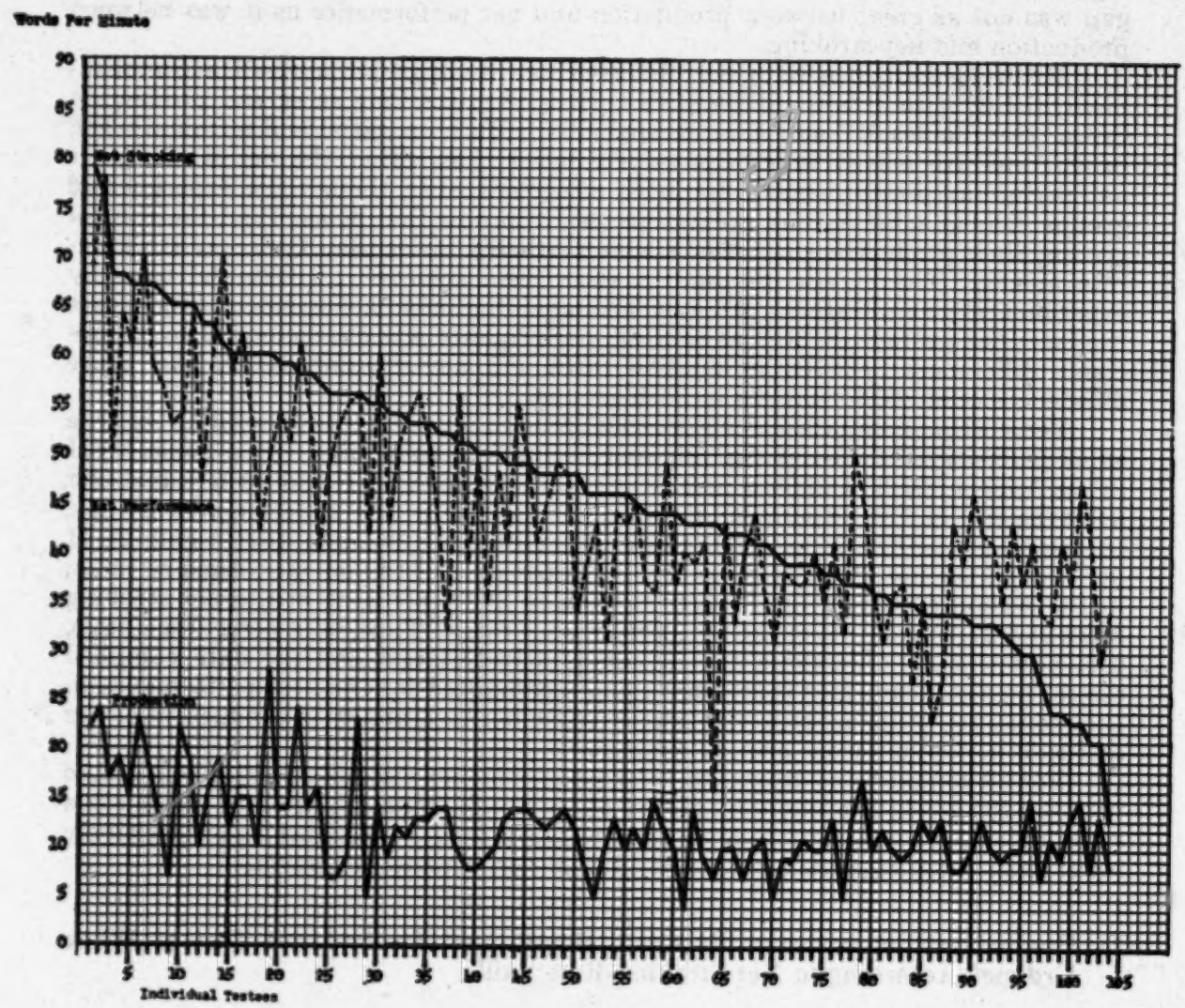

Figure 4. Final Net Stroking, Net Performance, and Production Rates for Second-Semester Testees

and on final tests, forty-two testees, or 34.42 per cent, achieved higher net performance than net stroking rates. In the second semester, similar contrasts were observed. On initial tests, forty-six testees, or 44.23 per cent of the total, attained higher rates on net performance than on net stroking; and on final tests thirty-nine testees, or 37.50 per cent, had net performance rates higher than their net stroking rates. Thus, while the inclusion of additional test demands generally resulted in lower performance rates, many typists reversed the general trend by attaining higher levels on the more complicated tests. As a general rule, the performance gap was not as great between production and net performance as it was between production and net stroking.

Mean-performance data corroborated the findings for over-all accomplishment, pointing to extreme differences between key-stroking rates and production rates. (See Tables XV and XVI in Appendix.) Both on initial and terminal tests, production-rate means were impressively lower than either the net stroking- or net performance-rate means. For both semesters, even though the experimental groups yielded substantially greater growth in production power than the control groups, their production-rate means were markedly lower than their key stroking-rate means. The highest production rates were achieved on terminal tests by experimental-group testees. All evidence involving mean achievement emphasizes the fact that average, as well as over-all, performance was characterized by appreciable differences between production rates and key-stroking rates; and those differences occurred for testees in both groups.

Percentage comparisons show that production rates amounted to only a small percentage of the net stroking and net performance rates. (See Table XVII in the Appendix.) The highest percentage relationships were found for terminal-test achievement of the experimental-group testees. For the experimental groups, therefore, in the first semester the production-rate scores amounted to only 25.11 per cent of the net stroking rates and 25.74 per cent of the net performance rates; in the second semester, production rates were 26.08 per cent of the net stroking rates and 27.10 per cent of the net performance rates. Thus, on a percentage basis, too, performance differences appear comparatively large; and the data compiled stress the significant fact that, even though computed for the best performance in each semester, there are still wide gaps existing between ability in production power and skill in copying from printed contest.

For all comparisons drawn, therefore, the evidence discloses decided differences between the levels of production ability and those of key-stroking skill. Production rates reflecting total performance requirements were consistently and decisively lower than those rates reflecting only limited performance demands.

D. Production Comparisons Between Upper- and Lower-Limit Testees When Grouped According to Net Stroking-Rate Skill.

To find the comparative differences in performance-rate gains, production rates for testees in the upper and lower class limits of distributions prepared for net stroking skill were studied. The t-test for significance of difference between the means was applied to learn whether differences between the mean performance of the contrasted groups were significant. (See Accompanying Table X.)

In the first semester, for both the control and experimental groups, mean differences in production gain between the upper- and lower-limit typists favored the upper-limit testees. For both groups, the differences between the means, reflected through their t-test values, were significant at the .01 level of confidence. Though the over-all performance of the experimental group favored the upper-bracket students, experimental-Class II revealed such extensive growth for lower-division testees, the difference between the mean performance for that class was significant at only the .10 level of confidence.

TABLE X

COMPARISON OF PRODUCTION-RATE GAINS FOR TESTEES IN UPPER AND LOWER NET STROKING-RATE GROUPS

	Classes		Cases		Upper 27 Per Cent			Lower 27 Per Cent			t Test
					Net Stroking	Production Gain		Net Stroking	Production Gain		
	Con.	Exper.	Total	27%	Mean	Mean	S.D.	Mean	Mean	S.D.	
1st. Sem.	I		37	10	56.00	5.60	2.5	27.30	2.30	1.3	3.47**
		II	37	10	57.60	14.60	4.0	25.80	11.10	3.5	1.98†
		III	17	5	63.20	18.00	3.4	14.80	8.00	1.8	5.26**
		IV	31	8	57.00	10.63	2.4	23.87	6.25	1.2	4.34**
		II-III-IV	85	23	58.61	13.96	4.3	22.74	8.35	3.3	4.81**
2nd. Sem.	A		22	6	53.50	3.67	.9	28.17	2.67	1.9	1.19
		B	32	9	57.67	13.22	3.1	23.11	7.33	1.8	4.67**
		C	26	7	58.86	10.43	2.3	23.43	7.14	1.5	2.99*
		D	24	6	53.50	12.00	2.2	23.33	7.17	1.6	4.05**
		B-C-D	82	22	56.91	11.95	3.2	23.27	7.00	2.0	6.04**

**Significant at the .01 level of confidence
*Significant at the .05 level of confidence
†Significant at the .10 level of confidence

In the second semester, the control group did not show a significant difference in mean production gain for testees in the contrasted groups, the upper-level testees gaining only 3.67 w.p.m. and the lower-level ones, a mere 2.67 w.p.m. Similar to the first semester, however, the experimental group did show a difference in mean production gain between groups favoring the upper-limit typists. As was true in the first semester, one of the experimental-group classes showed, contrary to over-all performance, a difference between the means significant at a level slightly under that found for the entire group. For example, the performance of Class C produced a t-test value significant at only the .05 level of confidence, one slightly below the level computed for the total experimental-group performance. The deviation from the general trend appeared to be caused by the slight gain of the upper-limit typists rather than an exceptionally high performance on the part of the lower-bracket students.

In each semester, then, one experimental-group class provided an exception to the general rule that upper-limit typists tend to gain more in production than lower-limit ones. In the first semester, the exception appeared to be traceable primarily to a relatively higher growth on the part of lower-limit testees in that particular class compared to other classes in the experimental group; in the second semester, however, the exception seemed to be traceable to the failure of upper-level students in that one class to gain comparatively as much as those in the same bracket in the other two experimental classes.

In the first semester, the control group showed a difference favoring the upper-limit typists; but in the second semester, no significant difference appeared between the extreme limits of the control group.

Thus, while the over-all evidence generally supported the premise that typists with highest key-stroking skill tend to gain more in production ability than those with lowest skill, data for three out of the eight classes involved proved to be exceptions to the general trend.

E. Performance Data in Selected Related Areas

This study attempted, further, to determine the effects of the contrasted teaching methods of growth in three areas commonly associated with production typewriting: (a) speed and accuracy of producing key strokes, (b) skill in preparing carbon copies and in making corrections, and (c) the acquisition of background information related to business typewriting.

TABLE XI

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON NET STROKING RATE GAIN

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	1.00	11.34	
	Exper.	85	5.89	10.20	2.30*
2nd.	Control	22	6.45	9.97	
	Exper.	82	6.27	8.69	0.08

*Significant at the .05 level of confidence

Results of net stroking tests showed that, in the first semester, the speed-emphasis (control) group, with a mean gain of 1.00 w.p.m., did not gain as much in net stroking skill as the production-emphasis (experimental) group, having a

mean gain of 5.89 w.p.m. In the second semester, however, the opposite condition existed although the extent of difference between the two groups was negligible. Of particular interest is the fact that the control group, while spending two thirds of the instruction time on speed building, did not produce, after a short period of nonspeed emphasis, significantly higher gains in net stroking skill than the experimental group which devoted no instruction time to formal speed building.

Tests administered to measure net performance skill resulted in rather inconclusive evidence. (See Table XII.)

TABLE XII

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON NET PERFORMANCE-RATE GAIN

Sem.	Group	N	Mean wpm	Standard Deviation	t Test
1st.	Control	37	6.65	8.83	1.15
	Exper.	85	8.41	8.34	
2nd.	Control	22	7.64	7.51	0.89
	Exper.	82	5.73	9.16	

In the first semester, the experimental group gained more in net performance skill than the control group; but the difference between the means proved to be a statistically insignificant one. In the second semester, however, the control group exceeded the experimental group in net performance gain; but, similar to the results of the first semester, the difference between the means proved to be statistically insignificant.

Worthy of note is the fact that accomplishment in net performance on straight copy represents achievement without benefit of formal instruction. Neither in the control nor experimental groups was there any attempt made to teach for proficiency in this particular area of performance; all tests were taken without special practice or preparation on the elements involved in that type of test.

Achievement on related information tests showed mean gains decisively in favor of the experimental groups. (See Table XIII.)

TABLE XIII

t-TEST FOR DIFFERENCES BETWEEN THE MEANS OF CONTROL AND EXPERIMENTAL GROUPS ON RELATED INFORMATION GAIN

Sem.	Group	N	Mean pts.	Standard Deviation	t Test
1st.	Control	37	30.89	15.45	6.39*
	Exper.	85	52.93	20.39	
2nd.	Control	22	33.32	12.37	3.86*
	Exper.	82	47.62	16.12	

*Significant at the .01 level of confidence

In both semesters, the experimental-group subjects demonstrated impressive increases over the control-group students in the amount of growth attained in the acquisition of related information. The t-tests for significance of differences between the means resulted, for both semesters, in values significant at the .01 level of confidence. From a study of the data, the production-emphasis method, providing

for a systematic, well-integrated program for teaching related information, emerged impressively superior to the speed-emphasis method which provided only brief, periodic coverage.

F. Relationships Between Production Gain and Selected Related Factors.

To find the relationships between production proficiency and ability in other selected areas, coefficients of correlation were computed for mean production gains and the following six factors: (1) net stroking rate, (2) net performance rate, (3) related information score, (4) ACE percentile rank, (5) reading comprehension score, and (6) an arithmetic test score. (See Table XIV.)

Using the Pearson product-moment coefficient of correlation to determine the relationships, it was found that, in the first semester, there were no r's indicating significant relationships between production gains and any of the six factors considered. Only one class in the experimental group (Class IV) showed a relationship as high as even the .10 level of confidence, and that was between production gain and net stroking skill. For both the control and experimental groups of the first semester, then, it may be observed that there were no statistically significant relationships existing between the factors studied.

In the second semester, however, different outcomes were discovered. Similar to the status of the first semester, the control group in the second semester failed to show any r suggesting significant relationships between production gain and the six factors analyzed. The experimental group, on the other hand, did show r's denoting significant relationships to exist between production gain and all six factors. Of especial interest, however, is the fact that, while the relationships for the total experimental group showed significance throughout, one of the three classes comprising the experimental group disclosed data to the contrary. Class C, completely reversing the pattern of over-all status, showed no significant relationships between its production gain and the six factors involved. Thus, in the second semester while there were noticeable differences between the relationships computed for the control and total experimental groups, one class in the experimental group did not conform to the over-all pattern. Noteworthy, however, is the fact that, even though the one experimental class revealed contrary relationships, the total experimental-group, including in its data those of the exceptional class, still indicated statistically significant relationships between production gain and each of the six factors enumerated. Further complicating the relationship picture, moreover, is the awareness that, at the beginning of the experiment, there were no significant differences existing between the control and experimental groups on five of the six factors included. Assuming, then, that the existent differences between the two opposing groups were traceable, possibly, to the effects of the contrasted teaching methods under investigation, it must be concluded that the methods involved resulted in a discrepant, rather than consistent, pattern of influence.

Careful, analytical study of the data provides no defensible explanations for differences found between groups and between semesters; generalizations based on those data, therefore, must, manifestly, be inconclusive.

TABLE XIV

COEFFICIENTS OF CORRELATION BETWEEN PRODUCTION GAINS AND SELECTED RELATED FACTORS

	Classes		N	Mean Production Gain		Beginning Net Stroking Rate	Beginning Net Performance Rate	Beginning Related Information Score	ACE Percentile Rank	Reading Comprehension C_2 Score	Arithmetic Test Score
	Con.	Exper.		wpm	wpm	r	r	r	r	r	r
1st. Sem.	I		37	3.70		0.23	0.21	0.14	0.18	0.18	0.14
		II	37		11.19	0.04	0.02	0.06	0.10	0.07	0.02
		III	17		12.52	0.30	0.20	0.30	0.09	0.08	0.28
		IV	31		8.65	0.33†	0.24	0.26	0.17	0.16	0.22
		II-III-IV	85		10.53	0.14	0.14	0.17	0.01	0.03	0.12
2nd. Sem.	A		22	3.36		0.08	0.01	0.02	0.04	0.01	0.11
		B	32		9.06	0.61*	0.65*	0.64*	0.56*	0.60*	0.69*
		C	26		7.92	0.03	0.02	0.02	0.01	0.01	0.05
		D	24		8.74	0.57*	0.58*	0.56*	0.60*	0.48♯	0.54*
		B-C-D	82		8.59	0.42*	0.61*	0.49*	0.43*	0.44*	0.49*

*Significant at the 0.01 level of confidence
♯Significant at the 0.02 level of confidence
†Significant at the 0.10 level of confidence

IV. IMPLICATIONS

The prime purpose of this investigation was to compare contrasted teaching methods for developing production typewriting ability. The curiosity underlying this vital concern about the relative merits of the two opposing methods under consideration results from a fundamental tenet in the educational philosophy of the writer, viz., that a basic challenge to all professional educators should be to strive constantly, through the avenues of research, to find ever-improved procedures for expanding the efficiency of the teacher in the classroom and, by so doing, to contribute to the enrichment of learning experiences. Therefore, as a result of this study arising from that curiosity, new evidence has been assembled for use in pointing the way to a more scientific approach to the urgent need for increasing teaching effectiveness in a very important phase of typewriting instruction.

This research has resulted in the compilation of data dealing with many facets of production typewriting, all of which were summarily reported in previous sections. Apart from interpretations of those data, however, the findings in themselves tend to have little other than encyclopedic value. To appreciate the true meaning of the data, then, they should be considered in terms of their potential influence on educational practice in ramified areas. Such postulated influences, therefore, are hereinafter enumerated as tenable implications.

Generally, implications drawn for educational purposes may involve any one or a combination of the following, among other, areas: (1) objectives, or scope of instruction; (2) course organization; (3) course content, or subject matter; (4) specific classroom procedures, or methods; (5) testing; (6) evaluation, or appraisal; (7) curriculum, involving length of course, grade placement; and (8) administrative policy. Thus, in a delineation of the possible implications of the findings of this study, the above-mentioned areas serve as foci for such considerations.

Careful deliberation and analyses of the data in this study result in the following observed implications:

1. To realize maximum growth in production typewriting ability, a method of teaching emphasizing efficient production techniques and procedures rather than speed building is preferred. Greatest gains in production performance were achieved in all instances by testees taught by the production-emphasis method; that was true when computed for equated group performance as well as for the performance of matched individuals. Production typewriting ability appears to be more successfully developed through the production-emphasis method especially designed for that purpose than through the traditional, speed-emphasis approach which places maximum stress upon speed of producing key strokes. The procedures outlined for the experimental method, then, are recommended as preferable for classroom use in teaching production typewriting.

2. To gain a more accurate picture of the total-performance ability of typists, production typewriting should have a broad, all-inclusive interpretation. The inclusion in performance time of all activities involved in completing business jobs has a very direct influence on the production rates attained. Production rates determined for comprehensive, rather than narrowly restrictive, performance tend to be considerably lower than those computed for short-interval, highly specialized performance; and, since typical office typing more nearly approaches the comprehensive, rather than limited, type of behavior, it appears imperative that typewriting instruction should provide opportunities for growth in those more complex experiences. It is recommended, therefore, that the scope of production typewriting be interpreted in the broad, all-inclusive, sense defined in this research.

3. Net stroking-rate scores may be seriously challenged as reliable indices of true typewriting ability for typists required to demonstrate their capacity to perform typewriting activities beyond the level of mere routine copying from printed context. Rates on key-stroking tests, being considerably higher than those attained on production tests, tend to portray an inaccurate picture of the actual performance ability of typists measured on comprehensive production tests. Data available through this study show a marked difference between the levels of achievement on net stroking and those attained on production performance. It is recommended that greater emphasis be placed upon comprehensive production-rate scores than upon the narrowly specialized key-stroking rates for a more accurate appraisal of the potential vocational competence of office typists.

4. Individual behavior on production tests requiring the successful completion of many nonstroking activities often reflects the need for intensive instruction in those nontyping areas. Typewriting courses designed to develop production ability should include instruction purposely directed toward improving behavior in the nontyping as well as key-stroking phases of production typewriting. To provide such training implies the need for adequate instruction time and very seriously challenges the feasibility of attempting to develop comprehensive production ability in abbreviated, short-term courses.

5. To enable typists to perform at high production levels, specific instructions must be provided for that purpose. Evidence for both semesters disclosed great performance gaps between key-stroking skill and production ability prior to the period of formal instruction. Speed in producing key strokes did not transfer automatically to comprehensive production performance; instead, initial performance data revealed that even typists with relatively high key-stroking rates had comparatively low rates on production tests. The need for instruction especially designed to develop production ability was evident through an inspection of initial-test performance data. Therefore, it is recommended that typewriting courses be organized to include intensive instruction in production techniques and procedures as herein suggested.

6. Intensive instruction for developing production ability also produces substantial gains in key-stroking power. Educators interested in providing opportunities for continued growth in stroking speed may realize their objectives through intensive, rather than casual, instruction in production typewriting. In the first semester of this study, the nonspeed group exceeded the speed group in net stroking gains; and in the second semester, approached the gains of the speed group very closely. The evidence did not show any over-all loss in net stroking skill due to the emphasis placed upon production typewriting. From the evidence compiled, it was found that classes emphasizing speed did not gain as much in production as those emphasizing production; on the other hand, it was found that the classes emphasizing production gained in net stroking, more in one instance and approximately as much in the other, as the classes devoting two thirds of their instruction time to speed building. Thus, it appears that opportunities for greater over-all development tend to be greater under the production-emphasis, rather than the speed-emphasis, method. It is suggested, then, that teachers interested in increasing net stroking rates while, at the same time developing production power, seriously consider the desirability of providing intensive training in production typewriting as an approach to the realization of both objectives.

7. Teaching methods should, in addition to other measures already used, include measurement of key-stroking skill on tests requiring the preparation of carbon copies and the correction of occurrent errors during the period of timing. Contrasts between net stroking and net performance rates show that the correction of errors on original and carbon copies proves to be a costly experience for typists on all levels of stroking skill. Moreover, since both of the factors are involved in

production typewriting, some training designed to develop proficiency in those areas seems highly desirable. Performance data showed a closer relationship between net performance rates and production rates than between net stroking rates and production. In many instances, typists having low net stroking rates attained higher rates on net performance tests than they did on net stroking tests. While that trend appeared more frequently on the lower levels of skill, there were numerous cases on other levels demonstrating the same behavior. Thus, it is suggested that teachers interested in providing classroom experiences comparable to those encountered by typists outside of the classroom include timed writings involving the activities required in the net performance tests defined in this study as part of their regular instructional program. The net performance test employed in this research seems especially appropriate for that type of training.

8. Items of related information deemed essential to problem solving and to business typing should be incorporated into a systematic, well-organized plan of instruction which provides constant emphasis, drill, and application of those items to practical problem situations. Test results of typists taught by the production-emphasis method in which related information was considered an integral part of the total production development program proved the superiority of that method over the speed-emphasis method which treated related information as only a casual concomitant. In both semesters, gains in the acquisition of related learnings favored most impressively the experimental-group testees. Since, as a general practice, items of related information not known by a typist are obtained through the use of reference manuals, valuable production time is lost on each occasion a vague or unknown related learning must be located. Thorough knowledge of essential, basic related information, therefore, tends to be a valuable contributant to production proficiency by eliminating the need for using valuable production time in search for information necessary for the completion of the jobs at hand. It is recommended, then, that a sound program for teaching related information be integrated with problem-solving experiences in each typewriting course.

9. Skill in key stroking is an important ingredient in production typewriting. As a general pattern, typists with the highest net stroking skill tended to gain more in production power than those having the lowest net stroking rates. While three out of eight classes did not support the general observation, the preponderance of evidence pointed to the superiority in production typewriting of testees in the upper-limit net stroking categories over those in the lower limits. Particularly significant, however, is the fact that, apart from specific instruction designed to teach the application of net stroking skill to production typewriting, net stroking rates appeared to be relatively meaningless indices of the ability of typists to perform on production tests.

10. Results of net stroking tests provide evidence for seriously questioning the desirability of emphasizing speed building, exclusively, for as long a time as thirty consecutive class periods. Performance of testees stressing speed for thirty continuous class sessions did not emerge significantly superior to that of testees in classes where speed building was not emphasized. There appears a very distinct possibility that a point was reached beyond which the law of diminishing returns in stroking increases ensued. Some thought should be given, perhaps, to the amount of time that may be profitably devoted to this one highly specialized, only comparatively important, typewriting activity. Of particular interest is the fact that the teacher directing the activities of the speed-emphasis group stated very positively in a written report to the author of this research that, in his judgement based upon student reaction and performance records, there was a definite decline in student interest as well as a corresponding pronounced impasse in continued growth in net stroking skill after approximately twenty consecutive lessons devoted to building speed. It is imperative, then, that since that influence of pupil interest

on learning success has long been established, this observed decline in enthusiasm for continued drives for higher stroking rates not be discounted.

Since the experimental-group testees, having no practice designed to improve stroking rates, exceeded in one semester, and approached very closely in the next semester, the gains in stroking achieved by the control group, and since in the opinion of the teacher conducting the speed-building program there was a point of diminishing returns reached after twenty continuous lessons, it very conceivably could logically follow that, as a result of the evidence compiled in this study, typewriting courses having as their objectives the development of production ability should not stress speed building, exclusively, for any more than twenty continuous lessons, the equivalent of four consecutive weeks. From the record, it might be reasonably deduced that little would be sacrificed in the area of speed building while much could be gained in the area of production typewriting through the adoption of such a plan.

11. Typewriting courses having as their objective the development of maximum production ability should include both production and speed building emphases. Since the greatest gains in production achievement were made by the upper-limit net stroking typists and since, on the other hand, greatest growth in production performance was attained by testees in the production-emphasis group, it appears that some provision for developing both competencies is mandatory. It is recommended, then, that courses organized for the purpose of developing production ability include short, periodic drives for increases in stroking rate followed by extended periods devoted to intensive instruction in production typewriting activities.

12. To develop comprehensive production ability, typewriting courses must be sufficiently long to make possible the realization of that objective. The evidence in this study points to the undesirability of short-term, abbreviated courses as ones suitable for developing production typewriting power. To have maximum accomplishment in production, both speed and production training appear essential; and both require extended periods of time for over-all group development. In this study, the control group, devoting only one-third of its instruction time to production typewriting, did not approach the level of proficiency attained by the experimental group which devoted the entire time to the development of production; and even after the intensive periods of instruction, the production rates were numerically low compared to the levels of net stroking achievement. Thus, to attain comparatively high levels of production performance, considerably more time for their realization would seem to be imperative. Typewriting courses extending for one year or less appear to be incompatible with the declared objectives of developing high rates of production performance when production typewriting is defined in a broad, all-inclusive, sense.

13. Additional research must be conducted before the relationships between production typewriting and the six related factors enumerated and studied in this research may be established. Because of inconsistent relationships revealed through this study, no conclusions can be reached concerning the comparative roles of the various factors in developing production typewriting ability. Further analysis of the factors selected, however, is recommended as subject-matter potential for future investigation.

14. Some provision should be made in typewriting courses for reinforcing the elements of basic arithmetic through a functional application of the fundamental math processes to typical office problems. Results of the arithmetic test administered in both semesters showed an unimpressive ability in accurately completing simple arithmetic computations. Since one of the avowed objectives of business education is to make valid contributions to general education, it would seem to follow that those contributions quite possibly might be made in areas of detected

need and in all courses providing opportunities for such integrated instruction. Test results showing, for a test consisting of forty-eight items, a mean in the first semester of 24.89 and in the second semester, 23.08, indicated rather forcefully an area of needed development; and production typewriting interpreted in its comprehensive sense abounds in opportunities for the application of the math processes to typical office problems. It is strongly recommended, therefore, that opportunities for reinforcing computational power in basic arithmetic be capitalized in production typewriting courses whenever possible.

15. The strength of the production-emphasis (experimental) method followed in this study appeared to be immeasurable enhanced by the observation that no testee in the experimental group failed to gain in production performance. Contrariwise, in the control, or speed-emphasis groups, two testees in each semester failed to register gains in production rates. Very probably, of course, that could have resulted from the short period of time available to speed-emphasis testees for developing production ability, since testees in the opposing groups having similar initial-test scores produced substantially higher gains in production achievement. Thus, it is further recommended that the experimental method employed in this study be considered favorably as an especially appropriate one for the realization of production gains regardless of initial performance status.

16. The production method used in this research appeared to be, administratively, equally effective for all classes regardless of the experience backgrounds of the teachers participating. Of the three different teachers directing the learning activities in the three experimental classes, one teacher had no previous teaching experience, one had fifteen years' experience, and one had six years' experience. In spite of the divergent experience backgrounds for the experimental groups, testees in those groups showed decided superiority over the control-group testees who were taught by one teacher having seven years' experience. Evidence compiled in this research points to the ease with which the production method may be followed and to the possibility of its successful adoption without regard to prior, or highly specialized, teaching experience. It is recommended, therefore, to teachers of typewriting, regardless of their experience backgrounds, as a highly successful method for developing competence in production typewriting.

APPENDIX

TABLE XV

SUMMARY OF FIRST-SEMESTER PERFORMANCE ON PRODUCTION, NET STROKING, AND NET PERFORMANCE TESTS

	Classes		Production			Net Stroking			Net Performance		
	Con.	Exper.	Range	Mean	S. D.	Range	Mean	S. D.	Range	Mean	S. D.
Initial Tests	I		7 1	4.00	1.1	67 21	42.68	11.4	55 15	38.19	9.6
		II	7 0	3.03	1.3	77 8	41.95	13.0	64 2	36.49	11.0
		III	4 0	2.35	1.1	73 11	38.93	20.2	63 9	37.63	16.3
		IV	8 0	2.29	1.5	72 9	41.36	13.5	62 10	35.03	12.2
		II-III-IV	8 0	2.62	1.4	77 8	41.13	14.9	64 2	36.19	12.6
Final Tests	I		15 4	7.70	2.8	73 −23	43.73	17.8	60 19	44.84	10.0
		II	26 8	14.22	4.1	87 27	47.62	12.5	84 29	44.81	12.2
		III	25 8	14.88	5.8	74 −30	43.82	25.3	73 16	45.35	15.4
		IV	21 5	10.94	3.2	79 13	47.13	13.2	68 22	43.94	10.7
		II-III-IV	26 5	13.15	4.5	87 −30	46.68	16.2	84 16	44.60	12.4

TABLE XVI

SUMMARY OF SECOND-SEMESTER PERFORMANCE ON PRODUCTION, NET STROKING, AND NET PERFORMANCE TESTS

	Classes		Production			Net Stroking			Net Performance		
	Con.	Exper.	Range	Mean	S. D.	Range	Mean	S. D.	Range	Mean	S. D.
Initial Tests	A		10 2	4.68	1.7	59 23	41.82	10.2	56 12	36.96	9.4
		B	10 1	4.56	1.6	75 9	40.34	14.4	74 17	38.66	12.6
		C	7 2	4.31	0.9	68 13	40.15	14.1	65 26	38.65	10.0
		D	13 2	4.88	2.2	61 18	38.77	11.9	72 16	40.74	13.3
		B-C-D	13 1	4.57	1.7	75 9	39.73	13.6	74 16	39.17	12.0
Final Tests	A		15 4	8.23	2.7	67 21	48.27	11.3	61 31	44.59	8.0
		B	24 8	13.66	4.6	79 13	46.56	14.7	78 33	46.59	11.6
		C	19 7	12.23	2.9	68 24	46.38	10.2	70 23	45.04	10.9
		D	28 7	13.54	4.7	67 21	44.83	14.5	64 16	42.08	11.3
		B-C-D	28 7	13.17	4.2	79 13	46.00	13.4	78 16	44.78	11.5

TABLE XVII

PERCENTAGE RELATIONSHIP OF PRODUCTION RATES TO NET STROKING AND NET PERFORMANCE RATES

	Classes		Initial Production Tests			Final Production Tests		
	Con.	Exper.	Mean wpm	Per Cent of Net Stroking Rate	Per Cent of Net Perform. Rate	Mean wpm	Per Cent of Net Stroking Rate	Per Cent of Net Perform. Rate
1st Sem.	I		4.00	9.37	10.47	7.70	17.60	17.17
		II	3.03	7.22	8.30	14.22	29.86	31.73
		III	2.35	6.03	6.24	14.88	33.95	32.81
		IV	2.29	5.53	6.53	10.94	23.21	24.90
		II-III-IV	2.62	6.37	7.24	13.15	28.16	29.48
		Total	3.04	7.30	8.26	11.50	25.11	25.74
2nd Sem.	A		4.68	11.19	12.60	8.23	17.04	18.45
		B	4.56	11.30	11.79	13.66	29.33	29.31
		C	4.31	10.73	11.15	12.23	26.36	27.15
		D	4.88	12.58	11.97	13.54	30.20	32.17
		B-C-D	4.57	11.50	11.66	13.17	28.63	29.41
		Total	4.59	11.44	11.87	12.12	26.08	27.10

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